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ABSTRACT

A study investigated the contributions of phonemic knowledge, prior knowledge, and listening comprehension to the reading comprehension of elementary age children. Three theoretical perspectives were followed aiming to specify developmental characteristics of these variables to reading comprehension: (1) contributions of prior knowledge should remain fairly stable across all age levels; (2) contributions of phonemic knowledge should account for the largest portion of the variance at beginning reading levels (ages 6-7) and decrease to significantly smaller amounts at higher reading levels (ages 10-12); and (3) listening comprehension contributions should increase across the 3 reading levels and rival the contributions of prior knowledge at the highest reading level. Subjects were 1200 children ages 8 to 12 years who were the normative sample of the Kaufman Assessment Battery for Children. Findings provide support for developmental shifts for phonemic knowledge as predicted. However, the contribution of prior knowledge diminished from 35-47% at the younger ages to approximately 3% of the variance at age level 10-12; while listening comprehension increased dramatically across the age levels, going from 6% at age levels 6-7 to 60% at age levels 10-12. (Contains 14 references and a table of data.) (Author/RS)

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Contributions of Phonemic Knowledge, Prior Knowledge, and Listening Comprehension to Elementary-Age Children's Reading Comprehension

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Abstract

This paper reports the results of a study investigating the contributions of phonemic knowledge, prior knowledge, and listening comprehension to the reading comprehension of elementary age children. Three theoretical perspectives were followed in an attempt to specify developmental characteristics of these variables to reading comprehension: (1) contributions of prior knowledge should remain fairly stable across all age levels, (2) contributions of phonemic knowledge should account for the largest portion of the variance at beginning reading levels (ages 6-7) and decrease to significantly smaller amounts at higher reading levels (ages 10-12 1/2), and (3) listening comprehension contributions should increase across the three reading levels and rival the contributions of prior knowledge at the highest reading level. The findings provide support for developmental shifts for phonemic knowledge as predicted. However, the contribution of prior knowledge diminished from 35-47% at the younger ages to approximately 3 % of the variance at age level 10-12 1/2. While listening comprehension increased dramatically across the age levels, going from 6% at age levels 6-7 to 60% at age levels 10-12 1/2.

Contributions of Phonemic Knowledge, Prior Knowledge, and Listening Comprehension to Elementary-Age Children's Reading Comprehension

Numerous models exist that attempt to explain the reading process. Most of these models are based on psychological components associated with skilled readers (Juel,1991). Three features are characteristic of many of these reading process models: (1) direct lexical access of words without phonological processing, (2) automatic or capacity free word recognition, and (3) the search for and construction of meaning. Whether or not these models of the reading process are generalizable to children who are acquiring reading capabilities is a relative unanswered question. Juel (1991), raises some interesting concerns about whether or not these common assumptions about the highly skilled reader can relate to children who are in the process of acquiring reading capabilities. First, can we reasonably expect the beginning reader to process text without some mediated form of word recognition based on phonological features of the words? Bypassing any mediated use of spelling-sound correspondence would suggest that beginning readers have developed an orthographic processing memory capacity that is not dependent upon phonological features of text. Second, is automatic processing of words the same for both skilled and beginning readers? It would seem theoretically supportable that automaticity is acquired through repeated exposure to various orthographic structural features of text and the features are incorporated into the

orthographic processor that enables direct lexical access to words. Finally, Juel (1991) raises the concern that prior knowledge of language and subject matter that readers use to construct meaning may vary in importance in relation to the reader's reading competency. Beginning readers may rely more on prior knowledge to construct meaning for text than do skilled readers.

In addition to the likelihood that word recognition, automaticity, and prior knowledge function differently in comparing skilled readers with beginning readers; the contribution that listening comprehension makes to reading comprehension at differing levels of reading competency is still unclear. Chall (1983) in her models of reading development argues that most of what children learn prior to stage 3 (reading for meaning from one point of view) is acquired through listening. A strong relationship between listening comprehension and reading comprehension has been reported in adult readers (Sticht & James, 1984). The relationship between listening skills and reading comprehension in the middle grades has been found to be moderate, and weak (but significant) in the elementary grades (Daneman, 1991). It would seem, however, that with elementary children at different levels of reading development we should see relative and significant changes in the contributions that phonemic knowledge, prior knowledge, and listening comprehension make to their reading comprehension performance.

Many researchers have argued that phonemic knowledge is a precursor to comprehension and contributes significantly to the reading development of young children (Adams, 1990; Chall, 1983). The role and importance of prior knowledge has

been well documented with skilled readers in relation to reading comprehension (Daneman, 1991). Furthermore, prior knowledge about a specific topic facilitates comprehension of text pertaining to that topic (Voss, Fincher-Kiefer, Greene, & Post, 1985). The contributions that listening comprehension make to reading comprehension not only makes sense from a logical perspective, but from an empirical perspective as well. Studies with advanced and adult readers have found that as reading competencies increase so does the amount of variance associated with listening comprehension (Daneman, 1991). Furthermore, some findings have indicated that reading comprehension and listening comprehension are indistinguishable in competent readers (Palmer, MacCleod, Hunt, & Davidson, 1985). The bulk of the research investigations focusing on phonological processing of words, prior knowledge utilization in construction of meaning, and listening comprehension capabilities influence on reading comprehension have been conducted with skilled readers. The results of this research have advanced the credibility that each of these variables plays a role in facilitating reading comprehension. However, a paucity of evidence exists to address concerns related to the elasticity of these variables as children acquire reading capabilities. It has often been assumed that prior knowledge is a pervasive variable at all levels of reading performance. That is, prior knowledge contributes significantly to facilitating reading comprehension regardless of the reading capabilities of the reader. In addition, many researchers have postulated that phonemic knowledge becomes automatic once readers progress beyond the decoding phase (Samuels, Laberge, & Bremer, 1978) and is characterized as being capacity-free processing. Thus, phonemic

knowledge contribution to reading comprehension should become insignificant once readers become proficient in comprehending text, if it is in fact capacity-free. Collectively, data regarding listening comprehension suggest that as readers become more proficient in comprehending text, there is an increase in the proportion of the variance accounted for by listening comprehension (Sticht & James, 1984).

The purpose of the present study was to assess the roles of phonological features of words, general prior knowledge, and listening comprehension in the development of children's reading comprehension at various stages of learning to read. We were primarily interested in the relative importance of each variable to children's reading comprehension across three age level to evaluate possible developmental changes.

Method

Subjects

Subjects for this study were 1200 children ages eight to twelve and one-half years. These children were the normative sample of the Kaufman-Assessment Battery for Children (K-ABC). With 100 children at each half-year age between 2 and 12 1/2, its 2000 subjects were selected to reasonably mirror the 1980 census. The 1200 subjects were split into three age groups intended to reflect developmental and instructional differences in the children's reading: 6 and 7 year olds, 8 and 9 year olds, and 10 through 12 1/2 year olds.

Materials

Measures of phonemic knowledge. The K-ABC includes both intelligence tests and achievement tests. Phonemic knowledge was identified as a function of seven linguistic

components derived from theory (Adams, 1990) and contained within the decoding subtest of the K-ABC. Subjects' responded to each word orally by pronouncing the written word for trained examiners. The total score was based on the number of words correctly recognized. Internal consistency reliability for the this subtest ranged from .89 to .97 for one year age samples from six to twelve and one-half years of age. Validities are all consistent, with correlations between .50 and .75 with other K-ABC achievement tests. The words on the list represent a wide range of word frequencies and a balance of common and less common words (Kaufman & Kaufman, 1983). Both phonetic (regular) and nonphonetic (irregular) pronunciations are represented in the list for the three age levels.

Each word in the list was analyzed to determine the presence of seven structural features. These features reflected the association between the graphemic sequences and patterns representing phonemic elements within the words. Structural features included total number of (1) phonemes, (2) consonant blends, (3) consonant digraphs, (4) silent markers, (5) vowel digraphs, (6) r-controlled vowels, and (7) syllables. We theorized that these features are predictable and were valid for inclusion in a reader's bank of associated feature recognizers that would activate the phonological processor for pronunciation of the stimulus word. That is, to correctly pronounce the word the reader must rapidly and accurately resolve the phonemic representation of the letter patterns. The structural features identified for each word were also likely and anticipated letters representing phonemic elements that would be restricted to a syllable; therefore, these features could not be split into two separate syllables within polysyllabic words and

violate the predictability nature necessary for chunking. Reliability between two judges of 1.0 was achieved.

Measures of prior knowledge. Prior knowledge has been defined by Alexander, Schallert, and Hare (1991) as "The sum of what an individual knows" (p.33). We used children's individual scores on the Faces and Places subtest of K-ABC Achievement Scale as a measure of their prior knowledge. The Faces and Places subtest requires the child to name a picture of a well known person, fictional character, or place. We felt that this subtest was an accurate sampling of general prior knowledge and measures children's interaction with their environment, interests, interaction with books (whether reading themselves or being read to), television viewing, and school learning (Kaufman & Kaufman, 1983). Reliability coefficients for internal consistency of the Faces and Places achievement subtest range from .79 to .86.

Measures of listening comprehension. The Riddles subtest of the K-ABC Achievement Scales was used as a measure of listening comprehension. The examiner reads aloud a description to the child and the child gives the name of the object, person, or concept being described. For example, at age levels 6-7, the child would listen to: "What is blown up, can be popped, and floats in the air?" and respond by naming the object (balloon). Children's performance on this subtest is highly dependent upon their ability to attend and concentrate and then integrate what they hear to form an oral response of the object, person, or concept being described. Kaufman and Kaufman (1983) note that Riddles, "measures language concepts with the auditory-vocal channel of communication and assesses several unique abilities: integration of sequentially

presented auditory stimuli, conceptual inference, and logical classification" (p.55). The mean reliability coefficient for school-age children for the Riddles Achievement Subtest is .87; with reliability coefficients ranging from .80 to .90.

Measures of reading comprehension. A measure of subjects' comprehension was based on the total score on the comprehension subtest of K-ABC. This measure requires subjects to demonstrate comprehension of text by using gestural, nonverbal responses which avoids variables such as short-term memory or interpretation of visual symbols (Kaufman & Kaufman, 1983). Subjects had to go directly to meaning after processing the text. As a result, one can assume that they had to utilize their orthographic and phonological knowledge in an instantiated manner to construct a correct interpretation for the text. Internal consistency reliability coefficients for the Reading for Understanding subtest range from .86 to .95 for one year age samples from six and one-half to twelve and one-half years of age.

Independent Variables

The seven structural features of phonemic knowledge noted earlier were employed as predictors of overall phonemic knowledge in an initial regression to determine their importance for each student. That is, separate regressions were performed for each student and the regression weights were captured in a data file. Since the total number of degrees of freedom was small (equal to the number of words presented at a given grade), and as many as 7 predictors plus intercept could be fit, the potential for nonconvergence was high for many students. This problem was alleviated in

great measure by examining between-subject regressions and selecting at each age level only those predictors that contributed to overall phonemic knowledge performance. Generalized least squares analysis produced the weights, which for some students were biased estimates; overall outcomes will be discussed in the results section.

In addition to the phonemic structure variables, prior knowledge, and listening comprehension were independent variables in forward (Type I sum-of-squares analyses) regressions for each age level.

Dependent variables

Reading comprehension was selected as the dependent variable.

Analysis

Planned regressions were conducted and order of entry was determined by theory: phonemic structure variables, prior knowledge, and listening comprehension. Also, the unique (Type II) sums of squares were examined. All phonemic structure variables were entered together and considered theoretically coherent as a set, so that individual structure coefficients and sums of squares were not considered.

A second set of analyses was conducted with only between-subject scores. That is, phonemic knowledge total (Reading-Decoding subtest score), prior knowledge, and listening comprehension were used to predict reading comprehension. This would allow comparison between a model requiring separate individual estimation versus one in which within-person average (for phonemic knowledge) was adequate. Another way to think of the difference is that the two models test whether subject-by phonemic structure interactions are needed to account for reading comprehension variance.

Results

Within-subject phonemic predictor-based analyses

Age 6-7. Approximately 81% of the reading comprehension variance was accounted for by the three predictor sets. Phonemic knowledge was the single largest contributor, with 40% of that variance, with most of that variance independent of the other predictors. Prior knowledge added almost as much as phonemic structure, 35%, and listening comprehension added only about 6%.

Age 8-9. Total variance accounted for in reading comprehension dropped somewhat, to about 73%. At this age phonemic knowledge was much less important, about 13% of the variance, while prior knowledge assumed a much larger role at this age, 47% of the variance. Listening comprehension added another 11%.

Age 10-12 1/2. While overall predictability of reading comprehension dropped to 66%, importance of the independent variables was completely reversed at this age level. Listening comprehension accounted for almost all of the explainable variance, 60%, while phonemic structure and prior knowledge accounted for only 3% and 2% of the variance, respectively.

Between-subject-based analyses

Quite similar analyses were produced at each age level, with almost identical squared-multiple correlations and predictor contributions. No results were practically different; statistical testing of model differences in these analyses is problematic and no adequate statistical test is believed to exist. Nevertheless, differences in variance percentages accounted for are small.

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insert Table 1 about here

Discussion

The results reported here are significant for both substantive and methodological reasons. First, with a nationwide, representative sample of children, the pattern of prediction of reading comprehension supports a model of reading development consistent with other recent theoretical and empirical results. Phonemic knowledge is a crucial part of young children's ability to comprehend text. This can be asserted without the caveat that the results are dependent upon students' writing or verbal ability; the students responded nonverbally to the directions in the text. As students mature and develop automaticity in reading comprehension, their reliance on phonemic structure decreases but does not completely fade, even for relatively mature readers at age 12.

Prior knowledge as measured in this study is a measure of crystallized intelligence (Horn, 1976) in the sense that general knowledge allows elaborated knowledge frameworks or structures, thus mediating text in terms more likely to be familiar to the student. For younger students, ages 6-9, prior knowledge appears to be crucial for their comprehension of text, but not for older students who, it may now be assumed, have a rich enough prior knowledge base to apply to text comprehension.

The importance of listening comprehension primarily for older students is quite unexpected and perhaps contrary to theory that would predict its importance for

younger children. One possible explanation is that for older, more competent readers prior knowledge is subsumed by listening comprehension, which becomes a measure of general language capability, and language comprehension capability is a greater source of individual differences (Daneman, 1991). In a related interpretation, listening comprehension may be the primary separator of more and less proficient readers by age 12 due to the increasing developmental differences to be found by that age. Developmental changes in school children are termed "fan-spread" models (Bryck & Weisberg, 1977), as listening comprehension represents the cumulative language capability of the student over 6-7 years of schooling and environmental interaction. Prior knowledge may itself be limited by the verbal, linguistic capability of the student, not only in how much is represented in knowledge structures, but how the structures are organized and accessed. Numerous developmental studies show differences in such structures in both animals and humans (Greenough, Black, & Wallace, 1987) due to stimulus variation in the environment.

The second finding of interest is methodological; it proved possible with the variables examined for a large representative sample of U.S. children to produce individual prediction models for relatively small samples of reading decoding. With those individual predictors it was also possible to predict quite accurately each student's reading comprehension. Such analyses have typically been considered infeasible without large samples of response. The implication for reading researchers is that individual prediction may be a realizable goal. On the other hand, the close correspondence between analyses based on within-subject predictions and on averages for the individual

obviate the need for separate, individual predictions for the variables studied here. Both models gave virtually identical results. For this research the conclusion is that while not all individuals will exhibit the same relative weights or importance for phonemic knowledge, the overall importance is identical whether individual or pooled models are used. Both yield a high degree of prediction of reading comprehension.

The results reported here provide support for developmental shifts in phonemic knowledge that have been suggested theoretically by Adams (1990), Chall (1983), and Stanovich (1986), and support instructional efforts that focus on assisting children to acquire a foundation in decoding skills early in their reading development. Concomitant to that is recognition that less and less emphasis on phonemic knowledge will be required for most children as they acquire competency in decoding text and gain facility with general language skills. The fact that phonemic knowledge remains a significant, albeit small, predictor for older children suggests that it may remain a stumbling block for poor comprehenders and efforts to improve automaticity in phonemic facility may bear fruit. That is, however, conjecture rather than established from the results of this study.

In addition to the support for the importance of phonemic knowledge in relation to young children's reading comprehension performance, it is interesting to note that the concern raised by Juel (1991) that prior knowledge may function differently at differing levels of reading competency was a valid one. Although we are not able to specify the qualitative difference associated with the functioning of prior knowledge, it is clear that the role of prior knowledge began to decrease significantly at the higher age level of

reading competency. The results do offer support that the role of prior knowledge varies in importance in relation to reader's competency. That is, beginning readers' comprehension performance can be predicted by their prior knowledge in combination with their phonemic knowledge (75% of a total 81% r-squared) in comparison with higher age level readers (5% of a total 60% r-squared).

A limitation is that the prior knowledge measure used here may be too general; a closer linkeage of children's prior knowledge with comprehension for a passage on the same topic may yield different results. That research is in progress now.

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Table 1 Within-subject phonemic predictor-based analyses

Variable	% of variance
6-7 Age group	
Phonemic knowledge	40.0
Prior knowledge	35.0
Listening comprehension	6.0
Total reading comprehension variance accounted for	81.0
8-9 Age group	
Phonemic knowledge	13.0
Prior knowledge	47.0
Listening comprehension	11.0
Total reading comprehension variance accounted for	73.0
10-12 1/2 Age group	
Phonemic knowledge	3.0
Prior knowledge	2.0
Listening comprehension	60.0
Total reading comprehension variance accounted for	66.0